

# BSEE Standards Workshop

## API 14A, 12th Edition Subsurface Safety Valves High Pressure High Temperature Approach

January 2014

New Orleans, LA

# API 14A, 12th Edition Overview

- API 14A – 12th edition

- Writing process initiated in May 2010

- Voting ballot distributed 18 December 2013

- Comments due 12 February 2014

- Planned for publishing April 2014

- Overall comprehensive update which includes major revisions

- Added new Validation Grades in lieu of Classes of Service

- V1-H, V1, V2, V3, V4-1 and V4-2 (extensive testing requirements per validation grade)

- Scope now includes injection valves

- Debris considerations added to operational parameters

- Insert valve consideration on SCSSV's (limits / pressure rating)

- Design methodology and analysis addition (including FEA/CFD)

- Validation testing updates (Class 1 and 2)

- Addition of new HPHT to define new requirements for HPHT valves



# API 14A, 12th Edition – HPHT Approach

## ■ Section 5.9 – User/Purchaser Grade Selection

—Validation Grade V1-H defined (5.9.1)

- Meets requirements of Annex H
  - Meets Annex B
  - Meets all Annex G requirements for V1 validation testing
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—HPHT defined (5.9.2)

- SSSVs with a working pressure rating greater than 15,000 psi
  - or -
- SSSVs with a temperature rating greater than 350°F
  - or -
- When required by the user/purchaser
- When any of these three requirements are fulfilled, the SSSV shall conform to Annex H

# API 14A, 12th Edition – HPHT Approach

- Sub-task group formed within API 14A TG to address how HPHT will be incorporated
  - Team conducted comprehensive review of API Technical Report 1PER15K-1
  - Critical topics identified that have pertinent effect on subsurface safety valves
  - Annex H was authored by full task group based on comparative review output from sub-task group



# API 14A, 12th Edition – HPHT Approach

- **Annex H – Verification and validation requirements for high pressure-high temperature environment**
  - Defines the additional verification and validation requirements that shall be followed in designing and manufacturing SSSV and secondary tools for use in HPHT environment
  - H.2 – Functional specification (User/purchaser requirements)
    - Additional requirements are to be specified including max flowing temperature, shut in static temperature, and duration of time that SSSV will operate at temperature
  - H.3 – Technical specification (Supplier/manufacturer requirements)
    - **Temperature effects** – use temperature de-rated yield strength and modulus of elasticity with testing on samples at mid-wall or mid radius conducted in accordance with ASTM E21
    - **Environmental effects** – compatibility of metals with well fluids shall be evaluated, limits on castings (API 20A), limits on welding/structural components

# API 14A, 12th Edition – HPHT Approach

- Annex H – Verification and validation requirements for high pressure-high temperature environment
  - H.3 – Technical specification (Supplier/manufacturer requirements)
    - **Non-metals** – completions and stimulation fluid exposure to be specified, compound evaluation for RGD and ageing along with compound validation
    - **Design verification** – User/purchaser specifies max anticipated shut-in tubing pressure (SITP) at the SSSV and specify  $RWP > SITP$ .
    - The component shall conform to the requirements of 6.4 and the following additional requirements:
      - Combined loading analysis, generate rated performance envelope
      - Perform an elastic-plastic FEA using ASME BPVC Section VIII, Div 2 clause 5.2.4 when the stresses exceed yield strength
      - These FEA methods require true stress true strain curves be developed using ASME BPVC Section VIII, Div 2 or Section VIII, Div 3

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# API 14A, 12th Edition – HPHT Approach

- Annex H – Verification and validation requirements for high pressure-high temperature environment

- H.3 – Technical specification (Supplier/manufacturer requirements)

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- **Design verification (continued)** –

- The component shall conform to the requirements of 6.4 and the following additional requirements:
    - Localized stress discontinuities and plastic localized yielding shall be considered in the design and evaluated by a qualified person to determine if the design is acceptable or if additional analysis is required;
    - When FEA has identified plastic strain is evident, ratcheting analysis shall be performed per ASME Boiler and Pressure Vessel Code Section VIII or ASME BPVC Section VIII, Div 2
  - **Design validation** – validation grade V1-H is normative, post-test NDE is required on all critically stressed components
  - **Scaling of HPHT SSSV's** – comprehensive material review for scaled designs (metal & non-metal) shall be reviewed and accepted

# API 14A, 12th Edition – HPHT Approach

- **Annex H – Verification and validation requirements for high pressure-high temperature environment**
  - H.4 – Additional supplier/manufacturer requirements
    - **Metals verification** – yield strengths and modulus of elasticity for components integral to the tubing string and the closure mechanism shall be documented at max rated operating temperature
    - **Functional test requirements** – rated WP used in Annex C, the rated shall be adjusted to account for the temperature de-rating effect on material property. This adjustment shall be done per the equation below:

$$RWP_A = RWP/TDR$$

Where:

$RWP_A$  = adjusted rated working pressure

$RWP$  = rated working pressure

$TDR$  = temperature de-rating factor

Equipment is evaluated during the functional test at a higher stress level relative to yield strength than is ever experienced in service



# API 14A, 12th Edition – HPHT Approach

- **Annex H – Verification and validation requirements for high pressure-high temperature environment**
  - H.4 – Additional supplier/manufacturer requirements (continued)
    - **Quality plan** – shall be prepared per ISO 10005 and 7.4 for each order placed and approved in writing by user/purchaser, any changes shall go through the same approval process
    - **Final design review** – supplier/manufacturer and the user/purchaser shall conduct a final design review to verify that the SSSV and secondary tools are suitable for the applicable HPHT environment

# Validation Testing Overview

## B.2 Test Agency V3 steps

- B.3 Gas flow test
- B.5 Liquid leakage test
- B.6 Unequalized opening test
- B.7 Operating-pressure test
- B.8 Propane test
- B.9 Nitrogen leakage test
- B.7 Operating-pressure test
- B.10 V3 water flow test
- repeat B.9, B.7, and B.10 four times
- B.5 Liquid leakage test
- B.11 Controlled-temperature test
- B.4 OD/ID Drift per B.4.2/B.4.3

**V3 validation completed**

## B.2.2 Test agency V2 steps

- B.7 Operating-pressure test
- B.12 V2 slurry flow test
- B.9 Nitrogen leakage test
- repeat B.12 and B.9 six times
- B.5 Liquid leakage test
- B.4 OD/ID Drift

## **New Requirements:**

- D.2 Temperature cycle test
- D.3 Differential opening testing
- D.4 Self-Equalizing Test (if applicable)

**V2 validation completed**

# Validation Testing Overview (continued)

**From a V2 validated valve, add:**

- G.3 Life Cycle testing
- G.4 Differential opening testing
- G.5 Equalization mechanism endurance testing
- G.6 Special feature validation
- G.7 ESSSV Electronics qualification (if applicable)
- Annex M Rated Performance Envelope

**V1 validation completed**

- Annex J Combined Loads Operational Test
- Annex L Dynamic piston seal test

**HPHT validation completed**

## **Optional Validation Testing**

- Annex I Extended Sand Endurance Testing
- Annex K Gas Slam Closure Testing
- Annex D Alternative Leak Rate Requirements

# Conclusion

- Questions?